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#### LIFTING DEVICE

[0001] The invention relates to a lifting device having a top part and a bottom part, having a lifting linkage which connects the top part to the bottom part and has at least two sub-linkages connected to one another via a central articulation, and having a drive unit for adjusting the height of the top part.

[0002] Such lifting devices are known from the prior art. Thus, for example, WO 98/46137 discloses such a lifting device for adjusting the height of a patient support. In this case, parallelogram structures are used as lifting linkages. The disadvantage with the known structures is that they require a comparatively large amount of installation space. Furthermore, particularly large forces are necessary for height adjustment and these forces, in addition, are not constant. It is also the case that different displacement speeds arise during the height adjustment. The known solutions, for example, are too large, involve too much design outlay and require excessively complicated control means.

[0003] In view of the above, it is an object of the present invention to provide a particularly straightforward lifting device. This object is achieved by a lifting device as claimed in claim 1 and a method as claimed in claim 8.

[0004] Accordingly, it is a basic idea of the invention to configure the lifting device such that the drive unit acts on a central articulation of a multi-part lifting linkage. This allows the lifting device to be of particularly straightforward and compact construction.

[0005] Advantageous embodiments of the invention can be gathered from the subclaims.

[0006] In a particularly advantageous embodiment of the invention, a scissors structure is used as sub-linkage (lifting rod). The amount of installation space which is required for the lifting device can thus be greatly minimized in relation to known constructions. If the lifting linkage comprises, for example, two scissors structures connected to one another in an articulated manner, then this double scissors structure can be used to adjust the height of a patient support, provided on the top scissors assembly, in an extremely confined amount of space.

[0007] Instead of a double scissors assembly, it is also possible to use a triple or quadruple scissors mechanism, if required by the application. When use is made of a multiple scissors structure, in addition, the design results in a particularly high level of rigidity and bending strength when laterally occurring forces are absorbed.

[0008] According to a further embodiment of the invention, it is particularly advantageous if the drive unit is designed for a rectilinear movement of the central articulation (joint) in the vertical direction. This is preferably achieved in that the drive unit acts directly beneath the central articulation. It is not just a constant displacement speed which is achieved as a result. The device according to the invention is also distinguished by more or less constant operative forces and particularly precise synchronization. Since preferably just a single drive unit is used, there is no need for any separate synchronization control. Arcuate pivoting of the lifting linkage and an associated need for more space are avoided.

[0009] Corresponding to a further embodiment, it is advantageous if the drive unit has a spindle and a motor. In relation to known solutions, which operate, in particular, with maintenance-intensive hydraulic cylinders, this type of drive unit is comparatively low-maintenance. A particularly advantageous arrangement in this context has proven to be one in which a vertically running spindle is driven, via a corresponding gear mechanism, by an electric motor with its axis of rotation running perpendicularly to the spindle axis. This allows a particularly space-saving construction of the lifting device.

[0010] The spindle used is preferably a trapezoidal spindle. Instead of this self-locking type of spindle, it is also possible to use other spindles, for example, ball screw spindles. The spindle, motor and gear mechanism are preferably designed such that the spindle flanks are always subjected to load. In contrast to hydraulic cylinders, of which the operating paths vary, depending on design, during operation, the present drive unit is thus free of play, i.e. there is no return play.

[0011] In a further embodiment of the invention, the motor is fastened on the bottom part, for example, on a base plate. This has the advantage that there is sufficient space for the motor-control means above the motor. Furthermore, there is no need for any moveable cable guide.

[0012] Instead of such a fixed motor, an alternative embodiment provides for a moveable motor which is fastened on the central articulation and moves up and down on the spindle.

[0013] The present invention is described hereinbelow with reference to exemplary embodiments which are explained in more detail with the aid of drawings, in which:

[0014] FIGURE 1 shows a perspective view of a first embodiment of the invention,

[0015] FIGURE 2 shows a perspective view of a second embodiment of the invention, and

[0016] FIGURE 3 shows a plan view of the second embodiment.

[0017] The lifting device 1 according to the invention essentially comprises a bottom part, in the form of a base plate 2, a top part, in the form of a patient support 3, and a lifting linkage, see FIGURE 1. The lifting linkage here is configured as a double scissors mechanism or double scissors structure 4. It comprises, for example, two scissors assemblies 5, 6 as sub-linkages, which are connected to one another in an articulated manner.

[0018] The bottom scissors assembly 6 is connected to the base plate 2 in an articulated manner by way of its front scissors feet 7. The rear scissors feet 8 of the bottom scissors assembly 6 are connected to one another via a slide 9 which, when the double scissors structure 4 is opened and closed, runs back and forth in the running direction 11 on a running rail 10 fastened on the base plate 2 (see FIGURE 2).

[0019] Between the front and the rear scissors feet 7, 8 of the bottom scissors assembly 6, a horizontally arranged electric motor 12 is fastened on the base plate 2. A hand crank for emergency operation of the lifting device 1 can be attached (not illustrated) at that end of the electric motor 12 which is directed toward the rear scissors feet 8. The axis of rotation 13 of the electric motor 12 here runs parallel to the running direction 11 of the slide 9. There is sufficient space for arranging a motor-control means (not depicted) above the electric motor 12. Located between the front scissors feet 7 is a toothed gear mechanism 14 which converts the rotary movement of the electric motor 12 into a linear movement of a telescopic spindle 15 which runs perpendicularly to the axis of rotation 13 of the electric motor 12 and is arranged between the front scissors feet 7 and beneath the front central articulation 16 of the double scissors structure 4. The telescopic spindle 15 is designed as a trapezoidal screw spindle (ACME spindle) and has its spindle head connected in an articulated manner to the front central articulation 16 of the double scissors structure 4 via a transverse connection 17.

**[0020]** For a height adjustment of the patient support 3, the electric motor 12 is switched on and the telescopic spindle 15 is extended and retracted. The central articulation 16 of the double scissors structure 4 here executes a rectilinear movement in the vertical direction 18 at a constant displacement speed, while the slide 9 moves in the running direction 11. The axis of rotation 13 of the electric motor 12 here runs perpendicularly to the spindle axis. For safety reasons, the gear mechanism 14 is a self-locking gear mechanism. The spindle flanks are always subjected to load, so that the telescopic spindle 15 does not exhibit any return play. The absolute-value sensor of a measuring system is fitted directly (not depicted) on the telescopic spindle 15.

**[0021]** An alternative embodiment provides a moveable motor 19, see **FIGURE 2**. The electric motor 19 here is fixed on the central articulation 16 of the double scissors structure 4 and, when the double scissors structure 4 opens and closes, moves up and down on a screw spindle 20 fixed on the base plate 2. With this exception, this embodiment corresponds to the embodiment described above, in particular in respect of the operating principles.

**[0022]** In relation to conventional standings surfaces, the invention makes possible a lifting device 1 which requires only a particularly small base surface area, see **FIGURE 3**, which depicts a plan view of a lifting device without a top part.